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**AQUATIC INVERTEBRATES AND HABITAT AT A FIXED  
STATION ON THE SHIELDS RIVER,  
PARK COUNTY, MONTANA**

July 23, 2001

**A report to  
the Montana Department of Environmental Quality  
Helena, Montana**

by  
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Missoula, Montana  
May 2002

## INTRODUCTION

This report is one of 38 brief interpretive summaries of data assembled as part of a statewide, multi-year study conducted by the Montana Department of Environmental Quality (MT DEQ). Each report discusses information generated from a single benthic invertebrate sample collection and habitat evaluation at a fixed station established on a gauged river or high-order tributary. The present treatise focuses on the aquatic community sampled on the Shields River near Livingston, Montana on July 23, 2001. The sample site was located by GPS reading at 45° 43' 35" N, 110° 27' 49" W, lying within the Montana Valley and Foothill Prairie Ecoregion (Woods et al. 1998). The sample was collected by personnel of MT DEQ. Sampling effort consisted of either a composite of four Hess samples, or a one-minute kicknet collection (Bukantis 1998). Habitat parameters were evaluated using the MT DEQ Macroinvertebrate Habitat Assessment Field Form for streams with riffle/run prevalence. Invertebrate samples were processed and animals identified by Rhithron Associates, Inc. Analysis of invertebrate assemblages was accomplished by applying the revised method (Bollman 1998) for streams of Western Montana's ecoregions. The method uses a multimetric battery to evaluate disturbance to biotic integrity.

The revised bioassessment metric battery and its scoring criteria have not been evaluated for application to higher-order streams and rivers; to date, no bioassessment method has been contrived for these waterways in Montana. Thus, the method used here is likely to have limitations in its applicability to the sites in this study. For example, 24 of the riverine or high-order waterways sampled for the fixed station study were located within Western Montana ecoregions and were sampled between July 23 and August 25, 2001. Mean water temperature for these sites at the time of sampling was 19.8°C (median = 19.4°). Temperatures ranged from 15.5°C (Kootenai River near Libby) to 25.3°C (Jefferson River near Three Forks). Ninety-eight sites from Western Montana were used to assemble the revised metric battery and to test it for sensitivity in detecting impairment, to establish scoring criteria, and to improve robustness of bioassessment. These 98 sites were mainly second and third order streams; the sampling season roughly corresponded to that of the fixed-station study. Mean water temperature for these sites at the time of sampling was 15°C (median = 14°C). Natural variations in benthic community composition and structure along longitudinal and thermal gradients are well known phenomena. Thus, scores and classifications were established for much smaller systems with significantly lower water temperatures; impairment classifications and use support designations in this study must be interpreted with care. Results from the application of other metric batteries may be found in the Appendix.

## RESULTS AND DISCUSSION

Table 1 itemizes the nine evaluated habitat parameters and shows the assigned scores for each, as well as the integrated score and condition category.

Overall habitat conditions scored sub-optimally at this site on the Shields River. Benthic substrate was perceived to be somewhat monotonous, and substrate particles were described as "cobble concreted on bottom", implying that embeddedness may have been worse than the parameter score implies. Heavy sediment was observed in pools. Streambanks were judged moderately stable, with areas of erosion on both sides of the

channel noted. Bank vegetation protection was appraised as sub-optimal. The riparian zone was abbreviated on both sides of the river.

**Table 1.** Stream and riparian habitat assessment for a fixed station on the Shields River. July 2001.

Max possible score	Parameter	Shields River near Livingston
10	Riffle development	10
10	Benthic substrate	8
20	Embeddedness	17
20	Channel alteration	12
20	Sediment deposition	10
20	Channel flow status	15
20	Bank stability: left / right	5 / 6
20	Bank vegetation: left / right	8 / 8
20	Vegetated zone: left / right	8 / 6
160	Total	113
	Percent of maximum CONDITION*	71 <b>SUB-OPTIMAL</b>

\*Condition categories: Optimal > 80% of maximum score; Sub-optimal 75 - 56%; Marginal 49 - 29%; Poor <23%.

Adapted from Plafkin et al. 1998.

**Table 2.** Metric values, scores, and bioassessment for a fixed station on the Shields River. The revised bioassessment metric battery (Bollman 1998) was used for the evaluation. July 2001.

Shields River near Livingston		
METRICS	METRIC VALUES	METRIC SCORES
Ephemeroptera richness	5	2
Plecoptera richness	0	0
Trichoptera richness	5	3
Number of sensitive taxa	0	0
Percent filterers	29.1	0
Percent tolerant taxa	42.5	0
	<b>TOTAL SCORE (max.=18)</b>	5
	<b>PERCENT OF MAX.</b>	28
	<b>Impairment classification</b>	<b>MODERATE</b>
	<b>USE SUPPORT</b>	<b>PARTIAL</b>

Bioassessment results are given in Table 2. When this bioassessment method is applied to these data, scores indicate that this site on the Shields River is moderately impaired and only partially supports designated uses.

The elevated biotic index (5.18) and low numbers of mayfly taxa (5) suggest that nutrient enrichment and/or warm water temperatures may impair water quality. The

measured water temperature at the time of sampling was 22.9°C, which is higher than the mean temperature of riverine sites in Western Montana visited for the fixed stations study. The taxonomic composition of the sampled assemblage also exhibits some evidence of nutrient enrichment; animals in taxa tolerant of saprobic conditions comprised 43% of organisms collected. These included the caddisflies *Helicopsyche borealis* and *Hydropsila* sp. Moderate abundance of the latter suggests that some filamentous algae may have been present at the site.

Only eleven “clinger” taxa were taken in the sample, which may reflect contamination of hard substrate habitats by fine sediment deposition. Taxa richness (26) was depressed compared to expectations, and predators were rare in the assemblage. This suggests limited instream habitats; these may have been compromised by sediment deposition, blooms of filamentous algae, embedded substrate, or other factors. The absence of stony taxa may have been associated with disruptions of reach-scale habitat features such as channel integrity, streambank stability, or riparian zone function.

All functional components of a healthy benthic assemblage were present at the site, but predator fauna were underrepresented.

## CONCLUSIONS

- Warm water temperatures and nutrient enrichment may limit the quality of the benthic fauna at this site.
- Some evidence of fine sediment deposition can be discerned in the data.
- Low taxa richness and dearth of predators suggest limited instream habitats.
- The bioassessment score appears to under-estimate the quality of the benthic fauna, but the impairment classification appears appropriate, given the tolerance characteristics and functional composition of the assemblage.

## LITERATURE CITED

Bollman, W. 1998. Improving Stream Bioassessment Methods for the Montana Valleys and Foothill Prairies Ecoregion. Master's (M.S.) Thesis. University of Montana. Missoula, Montana.

Bukantis, R. 1998. Rapid bioassessment macroinvertebrate protocols: Sampling and sample analysis SOP's. Working draft, April 22, 1997. Montana Department of Environmental Quality. Planning Prevention and Assistance Division. Helena, Montana.

Woods, A.J., Omernik, J. M. Nesser, J.A., Shelden, J., and Azevedo, S. H. 1999. Ecoregions of Montana. (Color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia. US Geological Survey.

**APPENDIX**

**Taxonomic data and summaries**

**Shields River**

**July 2001**

### Aquatic Invertebrate Taxonomic Data

Site Name: Shields River near Livingston

Site ID: Y03SHIER01

Date: 7/23/01

Approx. percent of sample used: 43

Taxon	Quantity	Percent	HBI	FFG
<i>Nais bretschneri</i>	35	11.44	8	CG
<i>Imnia</i> Tubificid with cap. setae	4	1.31	10	CG
<i>Sphaerium</i> sp	1	0.33	8	CF
Physidae	3	0.98	8	SC
<i>Acari</i>	2	0.65	5	PA
<b>Total Misc. Taxa</b>	<b>45</b>	<b>14.71</b>		
<i>Acentrella</i> sp. early instar	1	0.33	4	CG
<i>Baetis tricaudatus</i>	19	6.21	4	CG
<i>Attenella margarita</i>	3	0.98	2	CG
<i>Paraleptophlebia</i> sp.	1	0.33	1	CG
<i>Tricorythodes minutus</i>	22	7.19	4	CG
<b>Total Ephemeroptera</b>	<b>46</b>	<b>15.03</b>		
<i>Brachycentrus occidentalis</i>	13	4.25	2	CF
<i>Glossosoma</i> sp	2	0.65	0	SC
<i>Helicopsyche borealis</i>	15	4.90	3	SC
<i>Hydropsyche</i> sp	61	19.93	5	CF
<i>Hydropsyche</i> sp.	23	7.52	6	PH
<b>Total Trichoptera</b>	<b>114</b>	<b>37.25</b>		
<i>Optioscrus</i> sp	45	14.71	5	SC
<i>Zaitzevia</i> sp	3	0.98	5	CG
<b>Total Coleoptera</b>	<b>48</b>	<b>15.69</b>		
<i>Atherix</i> sp	3	0.98	4	PR
<i>Antocha</i> sp	3	0.98	3	CG
<b>Total Diptera</b>	<b>6</b>	<b>1.96</b>		
<i>Cricotopus</i> ( <i>Isocladus</i> ) Gr	6	1.96	7	CG
<i>Eukiefferiella</i> Gracci Gr	1	0.33	8	CG
<i>Paratanytarsus</i> sp	4	1.31	6	UN
<i>Polypedilum</i> sp.	6	1.96	6	SH
<i>Rheotanytarsus</i> sp.	14	4.58	6	CF
<i>Thienemannimyia</i> Gr.	1	0.33	5	PR
<i>Tvetenia</i> sp	15	4.90	5	CG
<b>Total Chironomidae</b>	<b>47</b>	<b>15.36</b>		
<b>Grand Total</b>	<b>306</b>	<b>100.00</b>		

### Aquatic Invertebrate Summary

Site Name: Shields River near Livingston

Date: 7/23/01

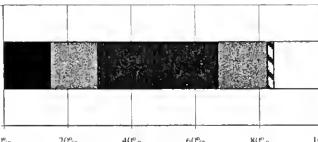
SAMPLE TOTAL 306

EPT abundance 160  
TAXA RICHNESS 26  
Number EPT taxa 10  
Percent EPT

52.29

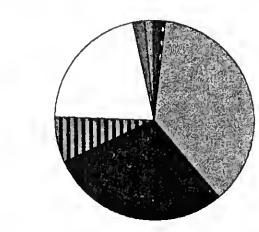
### TAXONOMIC COMPOSITION

GROUP	PERCENT	#TAXA	ABUNDANCE
Misc. Taxa	14.71	5	45
Odonata	0.00	0	0
Ephemeroptera	15.03	5	46
Plecoptera	0.00	0	0
Hemiptera	0.00	0	0
Megaloptera	0.00	0	0
Trichoptera	37.25	5	114
Lepidoptera	0.00	0	0
Coleoptera	15.69	2	48
Diptera	1.96	2	6
Chironomidae	15.36	7	47



### FUNCTIONAL COMPOSITION

GROUP	PERCENT	#TAXA	ABUNDANCE
Predator	1.31	2	4
Parasite	0.65	1	2
Gatherer	36.93	12	113
Filterer	29.08	4	89
Herbivore	7.52	1	23
Scraper	21.24	4	65
Shredder	1.96	1	6
Xylophage	0.00	0	0
Omnivore	0.00	0	0
Unknown	1.31	1	4



### COMMUNITY TOLERANCES

Sediment tolerant taxa	4
Percent sediment tolerant	10.46
Sediment sensitive taxa	1
Percent sediment sensitive	0.65
Metals tolerance index (McGuire)	4.24
Cold stenotherm taxa	0
Percent cold stenotherms	0.00

Site ID: Y03SHIER01

DOMINANCE		
TAXON	ABUNDANCE	PERCENT
<i>Hydroptilus</i> sp	61	19.93
<i>Optioscenis</i> sp	45	14.71
<i>Nais brevibasis</i>	35	11.44
<i>Hydroptila</i> sp	23	7.52
<i>Tricorynus minus</i>	22	7.19
SUBTOTAL 5 DOMINANTS	186	60.78
<i>Baetis tricaudatus</i>	19	6.21
<i>Helicopsyche borealis</i>	15	4.90
<i>Tetema</i> sp	15	4.90
<i>Rheumatobates</i> sp	14	4.58
<i>Brachynemourus occidentalis</i>	13	4.25
TOTAL DOMINANTS	262	85.62

SAPROBITY		
Hilsenhoff Biotic Index		5.18

DIVERSITY		
Shannon H (log <sub>e</sub> )		2.63

Shannon H (log <sub>2</sub> )		3.80
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Simpson D		0.10
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### VOLTINISM

VOLTINISM		
TYPE	ABUNDANCE	PERCENT
Multivoltine	85	27.70
Univoltine	160	52.37
Semivoltine	61	19.93

TAXA CHARACTERS		
#TAXA	ABUNDANCE	PERCENT
Tolerant	7	130
Intolerant	0	0.00
Clinger	11	180

### BIOASSESSMENT INDICES

B-BI (Karr et al. 1991)

METRIC	VALUE	SCORE
Taxa richness	26	3
E richness	5	3
P richness	0	1
T richness	5	3
Long-lived	2	1
Sensitive richness	0	1
%tolerant	42.48	3
%predators	1.31	1
Clinger richness	11	3
%dominance (3)	46.08	5
TOTAL SCORE	24	48 %

MONTANA DEQ METRICS (Bukantis 1998)

METRIC	VALUE	Plains Ecoregions	Valleys and Foothills	Mountain Ecoregions
Taxa richness	26	3	2	2
EPT richness	10	3	0	0
Biotic Index	5.18	2	1	0
%Dominant taxon	19.93	3	3	3
%Collectors	66.01	2	2	2
%EPT	52.29	3	2	1
Shannon Diversity	3.80	3		
%Scrapers + Shredders	23.20	2	2	0
Predator taxa	2	0		
%Multivoltine	27.70	3		
%H of T	53.5		3	
TOTAL SCORES		24	15	8
PERCENT OF MAXIMUM		80.00	62.50	38.10
IMPAIRMENT CLASS		SLIGHT	SLIGHT	MODERATE

